Ambient Air Pollution and Hospital Admissions: Evidence from South Korea

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Ambient Air Pollution and Hospital Admission: Evidence from South Korea

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OBJECTIVES

To estimates the health effects of air pollution:

- respiratory hospital admissions due to increases in PM_{10} and O_3 concentrations
- taking into account avoidance behavior
- differentiated effects on chronic vs. general respiratory patients

INTRODUCTION

- Several studies emphasizing the relationship between air pollution and health have been conducted in recent decades.
- An important part overlooked by many previous papers on the health effects of air pollution is that as air pollution increases, the number of hospital visits for treatment does not rise monotonically.
- This paper estimates the health effects of air pollution and examines the effects of avoidance behaviors on these estimates in South Korea.
- The Korean medical system provide a good environment for studying acute adverse health effects of air pollution on health: a) single health care network; b) easy accessibility to a hospital or healthcare facility; c) low healthcare costs.

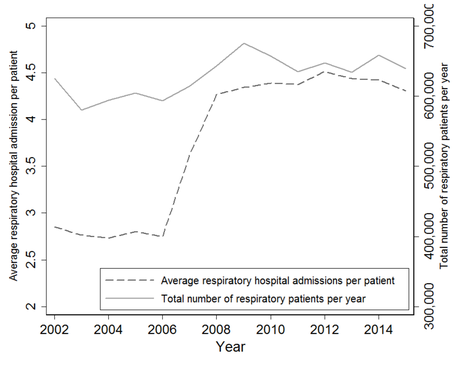

Figure 1: Respiratory hospital admissions

DATA

The following data were used:

- Hospitalization data: Korean National Health Insurance Service (NHIS)
- Air quality information: Korea Environment Corporation (KECO)
- Weather monitoring data: Korea National Climate Data Service System (NCDSS)

The data cover:

- 7 metropolitan cities and 9 provinces in South Korea
- January 1, 2006 – December 31, 2015

AVOIDANCE BEHAVIOR

According to the "Clean Air Preservation Act," the Korean Ministry of Environment (MOE) issues advisories or warnings in three situations:

- Asian dust storms
- high levels of particulate matter (PM_{10}, $PM_{2.5}$)
- high levels of ozone

When an alert is issued, people try to avoid all outdoor activities as much as possible, including hospital care. Hence, estimates of health effects of air pollution that do not take avoidance behavior are underestimated.

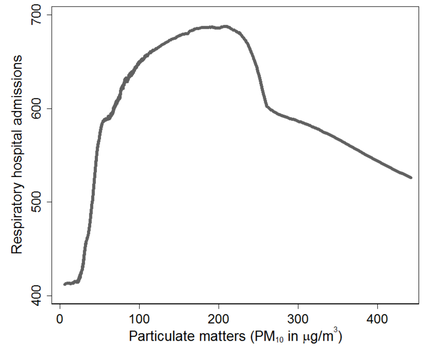

Figure 2: Respiratory hospital admissions and PM_{10}

EMPIRICAL STRATEGY

Poisson regression is the starting point for count data analysis. Poisson distribution, however, relies on a key assumption that the conditional variance is equal to the conditional mean. In this study, I estimate a Poisson quasi-maximum likelihood estimator that relaxes the assumption:

$$E[y_{ct} \mid X_{ct}, M_{ct}, \delta_c] = \delta_c exp(\beta_1 PM_{10ct} + \beta_2 Alert_{ct} + \beta_3[Alert_{ct} \times PM_{10ct}] + \beta_4 X_t + \beta_5 M_t + \beta_6 f(t)) \quad (1)$$

where

- y_{ct}: daily respiratory hospital admissions
- $Alert$: dummy that equals 1 if the daily average PM_{10} level is greater than 80 $\mu g/m^3$, 0 otherwise
- X_{ct}: humidity and temperature
- M_t: dummy variables for day of week, holiday, month, year
- $f(t)$: time trends (t and t^2)
- δ_c: city/province fixed effect

RESULTS

	1	2		3	4
PM_{10}	0.0001***	0.0005***	O_3	0.003	0.004**
	(0.00002)	(0.00007)		(0.002)	(0.002)
Alert		0.026***	Alert		0.063*
		(0.007)			(0.035)
$PM_{10}\times Alert$		-0.0005***	$O_3\times Alert$		-0.023***
		(0.0001)			(0.008)

Table 1: Health effects of air pollution and avoidance behavior

	1	2		3	4
	Chronic	General		Chronic	General
PM_{10}	0.00049***	0.00062***	O_3	0.0039***	0.0035***
	(0.00004)	(0.00003)		(0.0008)	(0.0005)
Alert	0.02019***	0.02786***	Alert	0.0241	0.0324*
	(0.00435)	(0.00309)		(0.0232)	(0.0171)
$PM_{10}\times Alert$	-0.00048***	-0.00053***	$O_3\times Alert$	-0.0130**	-0.0116***
	(0.00005)	(0.00004)		(0.0051)	(0.0037)

Table 2: Health effects of air pollution on general and chronic respiratory patients

CONCLUSION

- A 10 $\mu g/m^3$ increase in PM_{10} leads to a 0.5 percent increase in respiratory hospital admissions.
- This is 5 times larger than the estimate that does not take into account air quality information, suggesting that people respond to PM_{10} alerts and estimates omitting avoidance behavior are downward biased.
- A 0.01 ppm increase in O_3 leads to a 0.4 percent increase in respiratory hospital admissions. The estimate of the effect of ozone on hospital admissions that does not include ozone alerts is 0.3 percent, suggesting that omitting alerts for ozone may give rise to a smaller and even statistically insignificant estimate.
- O_3 has larger impacts on patients with chronic respiratory diseases, while PM_{10} has greater impacts on general respiratory patients.

POLICY IMPLICATIONS

- Korean government's guidance on air pollution only recommends that chronic respiratory patients be given more care, regardless of the type of air pollutant.
- Korean government should revise their guidelines for air pollution to take into account the different effects of both air pollutants.

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